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PATENT

Preliminary Classification:

Proposed Class:

Subclass:

NOTE: "All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example 'Proposed Class 2, subclass 129.'" M.P.E.P. Section 601, 7th ed.

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22387 U.S. PTO
10/666740
09/19/03

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of
Inventor(s):

RONALD R. SAVIN

WARNING: 37 C.F.R. Section 1.41(a)(1) points out:

"(a) A patent is applied for in the name or names of the actual inventor or inventors.

(1) The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by Section 1.63, except as provided for in Section 1.53(d)(4) and Section 1.63(d). If an oath or declaration as prescribed by Section 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to Section 1.53(b), unless a petition under this paragraph accompanied by the fee set forth in Section 1.17(l) is filed supplying or changing the name or names of the inventor or inventors."

For (title): PROCESS FOR DRY MILLING ZINC POWDER TO PRODUCE ZINC FLAKE

CERTIFICATION UNDER 37 C.F.R. 1.10*

(Express Mail label number is mandatory.)

(Express Mail certification is optional.)

I hereby certify that this correspondence and the documents referred to as attached therein are being deposited with the United States Postal Service on this date September 19, 2003, in an envelope as "Express Mail Post Office to Addressee", mailing Label Number EV 327550013 US, addressed to the Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450

GERALDINE MARTI

(type or print name of person mailing paper)

Geraldine Marti

Signature of person mailing paper

WARNING: Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

***WARNING:** Each paper or fee filed by "Express Mail" must have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. 1.10(b).

"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will not be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

1. Type of Application

This new application is for a(n)

(check one applicable item below)

Original (nonprovisional)
 Design
 Plant

WARNING: *Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. 371(c)(4), unless the International Application is being filed as a divisional, continuation or continuation-in-part application.*

WARNING: *Do not use this transmittal for the filing of a provisional application.*

NOTE: If one of the following 3 items apply, then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION.

Divisional.
 Continuation.
 Continuation-in-part (C-I-P).

2. Benefit of Prior U.S. Application(s) (35 U.S.C. Sections 119(e), 120, or 121)

NOTE: *A nonprovisional application may claim an invention disclosed in one or more prior filed copending nonprovisional applications or copending international applications designating the United States of America. In order for a nonprovisional application to claim the benefit of a prior filed copending nonprovisional application or copending international application designating the United States of America, each prior application must name as an inventor at least one inventor named in the later filed nonprovisional application and disclose the named inventor's invention claimed in at least one claim of the later filed nonprovisional application in the manner provided by the first paragraph of 35 U.S.C. Section 112. Each prior application must also be:*

(i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or
(ii) Complete as set forth in Section 1.51(b); or
(iii) Entitled to a filing date as set forth in Section 1.53(b) or Section 1.53(d) and include the basic filing fee set forth in Section 1.16; or
(iv) Entitled to a filing date as set forth in Section 1.53(b) and have paid therein the processing and retention fee set forth in Section 1.21(l) within the time period set forth in Section 1.53(f).

37 C.F.R. Section 1.78(a)(1).

WARNING: *If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. §§120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. §§ 120, 121 or 365(c). (35 U.S.C. 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. §§ 119, 365(a) or 365(b).) For a C-I-P application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.*

WARNING: 37 C.F.R. § 1.78(a)(2) deals with the time in which the claim for the benefit of an earlier filing date must be made and states:

"(2)(i) Except for a continued prosecution application filed under § 1.53(d), any nonprovisional application or international application designating the United States of America claiming the benefit of one or more prior-filed copending nonprovisional applications or international applications designating the United States of America must contain or be amended to contain a reference to each such prior-filed application, identifying it by application number (consisting of the series code and serial number) or international application number and international filing date and indicating the relationship of the applications. Cross references to other related applications may be made when appropriate (see § 1.14)."

(ii) This reference must be submitted during the pendency of the later-filed application. If the later-filed application is an application filed under 35 U.S.C. 111(a), this reference must also be submitted within the later of four months from the actual filing date of the later-filed application or sixteen months from the filing date of the prior-filed application. If the later-filed application is a nonprovisional application which entered the national stage from an international application after compliance with 35 U.S.C. 371, this reference must also be submitted within the later of four months from the date on which the national stage commenced under 35 U.S.C. 371(b) or (f) in the later-filed international application sixteen months from the filing date of the prior-filed application. These time periods are not extendable. Except as provided in paragraph (a)(3) of this section, the failure to timely submit the reference required by 35 U.S.C. 120 and paragraph (a)(2)(i) of this section is considered a waiver of any benefit under 35 U.S.C. 120, 121, or 365(c) to such prior-filed application. The time periods in this paragraph do not apply if the later-filed application is:

- (A) An application for a design patent;
- (B) An application filed under 35 U.S.C. 111(a) before November 29, 2000; or
- (C) A nonprovisional application which entered the national stage after compliance with 35 U.S.C. 371 from an international application filed under 35 U.S.C. 363 before November 29, 2000.

(iii) If the later-filed application is a nonprovisional application, the reference required by this paragraph must be included in an application data sheet (§ 1.76), or the specification must contain or be amended to contain such reference in the first sentence following the title.

(iv) The request for a continued prosecution application under § 1.53(d) is the specific reference required by 35 U.S.C. 120 to the prior-filed application. The identification of an application by application number under this section is the identification of every application assigned that application number necessary for a specific reference required by 35 U.S.C. 120 to every such application assigned that application number."

NOTE: If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

The new application being transmitted claims the benefit of prior U.S. application(s). Enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed

A. Required for Filing Date under 37 C.F.R. Section 1.53(b) (Regular) or 37 C.F.R. Section 1.153 (Design) Application

8 Pages of Specification
2 Pages of Claims
 Sheets of Drawing

WARNING: *DO NOT submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to Section 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. For comments on proposed then-new 37 C.F.R. 1.84, see Notice of March 9, 1988. (1990 O.G. 57-62).*

NOTE: *"Identification of drawings. Identifying indicia, if provided, should include the title of the invention, inventor's name and application number, or docket number (if any) if an application number has not been assigned to the application. If this information is provided, it must be placed on the front of each sheet and centered within the top margin."*

(complete the following, if applicable)

The enclosed drawing(s) are photograph(s).

NOTE: 37 C.F.R. 1.84

"(b) Photographs.

"(1) Black and white. Photographs, including photocopies of photographs, are not ordinarily permitted in utility and design patent applications. The Office will accept photographs in utility and design patent applications, however, if photographs are the only practicable medium for illustrating the claimed invention. For example, photographs, or photomicrographs of: electrophoresis gels, blots (e.g., immunological, western, Southern and northern), auto radiographs, cell cultures (stained and unstained), histological tissue cross sections (stained and unstained), animals, plants, in vivo imaging, thin layer chromatography plates, crystalline structures, and in a design patent application, ornamental effects, are acceptable. If the subject matter of the application admits of illustration by a drawing, the examiner may require a drawing in place of the photograph. The photographs must be of sufficient quality so that all details in the photographs are reproducible in the printed patent.

"(2) Color photographs. Color photographs will be accepted in utility and design patent applications if the conditions for accepting color drawings and black and white photographs have been satisfied. See paragraphs (a)(2) and (b)(1) of this section."

The enclosed drawing(s) are in color. Three (3) sets of color drawings and a "PETITION TO ACCEPT COLOR DRAWING(S)" are attached. 37 C.F.R. §§ 1.84(a)(2) and 1.84(b).

NOTE: 37 C.F.R. 1.84(a)

"(2) Color. On rare occasions color drawings may be necessary as the only practical medium by which to disclose the subject matter sought to be patented in a utility or design patent application or the subject matter of a statutory invention registration. The color drawings must be of sufficient quality such that all details in the drawings are reproducible in black and white in the printed patent. Color drawings are not permitted in international applications (see PCT Rule 11.13), or in an application, or copy thereof, submitted under the Office electronic filing system. The Office will accept color drawings in utility or design patent applications and statutory invention registrations only after granting a petition filed under this paragraph explaining why the color drawings are necessary. Any such petition must include the following:

- (i) *The fee set forth in § 1.17(h);*
- (ii) *Three (3) sets of color drawings;*
- (iii) *A black and white photocopy that accurately depicts, to the extent possible, the subject matter shown in the color drawing; and*

acquisition mode (a reference image acquisition mode) to photograph a reference image, which is to be detailed later, in order to obtain foreign matter information, as the photographing mode. It is to be noted that the normal mode may include a plurality of sub-modes corresponding to various types of subjects.

[0026] The image-capturing element 8 generates image signals which correspond to an optical image formed in the image-capturing area by the variable optical system 3. These image signals undergo a specific type of analog signal processing at the analog signal processing unit 12 and are then output to the A/D conversion unit 13 as analog processed image signals. The image signals having undergone the analog processing are digitized at the A/D conversion unit 13 which then provides the digitized image signals to the image processing unit 15 as image data.

[0027] It is assumed that in the electronic camera 1 achieved in the embodiment, the image-capturing element 8 is constituted of a typical single-plate color image-capturing element having R (red), G (green) and B (blue) color filters arranged in a Bayer array and that image data adopting the R G B colorimetric system are provided to the image processing unit 15. Each of the pixels constituting the image data holds color information corresponding to one of the three color components, R, G and B. While each of the photoelectric conversion elements constituting the image-capturing element 8 is referred to as a pixel in this context, each unit of the image data corresponding to a pixel is also referred to as a pixel. In addition, an explanation is given based upon the concept that an image, too, is constituted of a plurality of pixels.

[0028] The image processing unit 15 executes image processing such as interpolation, gradation conversion and edge emphasis on such image data. The image data having undergone image processing then undergo a specific type of compression processing at the compression/decompression unit 19 as necessary, and are recorded into the memory card 30 via the memory card interface unit 22.

[0029] The image data having undergone the image processing are provided to the PC 31 via the memory card 30. The image data may be provided to the PC 31 via the external interface unit 23 and a specific type of cable or a wireless transmission line. It is assumed that the image data having undergone the image processing have been interpolated with color information corresponding to all three color components R, G and B present at each pixel.

(Foreign Matter Effect Elimination Processing)

[0030] Next, the processing executed to eliminate the undesirable effects of foreign matter from individual sets of photographic image data is explained. In the embodiment, a method whereby a reference image used to obtain foreign matter information is photographed and the foreign matter effect is eliminated from a plurality of images obtained under varying optical photographing conditions by using the reference image is adopted. However, the reference image is not constituted of completely uniform or homogeneous white reference data but instead is obtained by photographing a blue sky, an almost uniform wall surface, a gray chart, a solid color paper surface or the like. The reference data used for this purpose may contain information indicating peripheral darkening of the lens, the gradation of the subject and the shading at the image-capturing element and the like. The reference data should be the type of data available under conditions in which a photographing operation can be performed easily at a readily accessible location and do not need to be completely uniform since they are converted to uniform reference data by using an algorithm on the image processing side.

(Operation Executed on the Electronic Camera Side)

[0031] Before photographing an image, the user selects either photographing mode, i.e., the normal mode or the foreign matter information acquisition mode described earlier. The electronic camera 1 alters file information in the captured image data to be recorded into the memory card 30 in correspondence to the selected photographing mode.

[0032] FIG. 3 presents a flowchart of the processing executed in the electronic camera 1 during a photographing operation. This processing is executed when the user selects either photographing mode as described above. In step S1 in FIG. 3, a decision is made as to whether or not an instruction to continue with a photographing operation has been issued. The processing in step S1 is executed so as to allow the processing in FIG. 3 to be terminated promptly once the user issues an instruction to end the photographing operation, except for during the execution of the photographing operation or while photographic image data are being recorded. If the user has issued an instruction to continue with the photographing operation, i.e., if either of the photographing modes has been selected as described earlier, the operation proceeds to step S2. Otherwise, i.e., if the user has not selected either of the photographing modes and has issued an instruction to end the photographing operation, the processing in FIG. 3 ends.

[0033] In step S3, a decision is made as to whether or not the selected photographing mode is the foreign matter information acquisition mode. If the foreign matter information acquisition mode is currently selected, the operation proceeds to step S6. In step S6, the photographing conditions (the aperture, the image processing details, etc.) under which a reference image is to be photographed as explained later, are set in the electronic camera 1. If the foreign matter information acquisition mode is not currently selected, i.e., if the normal mode is currently selected, the operation

proceeds to step S3. At this time, the photographing conditions under which a subject is to be photographed in a normal manner are set in the electronic camera. The settings for the photographing conditions under which the normal photographing operation is to be executed may be pre-selected in correspondence to the type of subject, or the settings may be adjusted by the user.

5 [0034] The processing in steps S3 to S5 explained below is executed in the normal mode. In step S3, a decision is made as to whether or not a photographing instruction has been issued. If the user has issued a photographing instruction through an operation of the shutter release button or the like, the electronic camera 1 executes a photographing operation in the next step S4, and then the captured image data are recorded into the memory card 30 shown in FIG. 2 in step S5. The captured image data recorded in step S5 become a correction target of image correction processing 10 executed by the PC 30, which is to be explained later. If it is decided in step S3 that no photographing instruction has been issued or after executing the processing in step S5, the operation returns to step S1.

15 [0035] A file name is set in the captured image data (correction target image data, normal image data) recorded into the memory card 30 in step S5. The file name contains an extension indicating the file type, and the portion following ":" (dot) toward the end of the file name constitutes the extension. Specifically, the file name set for the correction target image data is presented as "<xx (name inherent to each file)>.<yy (extension)>". The "xx" portion is constituted of characters or symbols, whereas the "yy" portion is constituted of several alphabetic letters which are predetermined in correspondence to the file type.

20 [0036] In addition, tag information is attached onto the correction target image data. The tag information is metadata (data having written therein information on the base data and used in file information management) containing, for instance, information indicating the settings selected in the electronic camera 1 at the time of file generation and the date/time of the file generation. In other words, the tag information includes information related to the captured image. The tag information attached to the correction target image data does not affect the base image data. Namely, even if the tag information is modified, the correction target image data do not become altered. The image data correspond to the individual pixels constituting the image.

25 [0037] In step S5, "JPG" is set for the extension of the file name and tag information indicating that the photographing operation was performed in the normal mode is attached. It is to be noted that the "JPG" set in the extension indicates that the image file was compressed by adopting the JPEG (Joint Photographic Experts Group) method, which is a widely used image data compression method. Namely, the compression/decompression unit 19 shown in FIG. 2 compresses the image data through the JPEG method. It is to be noted that a different extension may be used and that another method may be adopted to compress image data. As an alternative, the image data do not need to be compressed.

30 [0038] The processing in steps S6 through S9 explained below is executed in the foreign matter information acquisition mode. In step S6, the photographing conditions under which the reference image is to be photographed are set. In this embodiment, the photographing conditions such as the F value (aperture value) and image processing details 35 are set as follows. It is to be noted that the specific terms used to refer to the individual settings are not limited to those used below, and any terms may be used as long as they refer to similar setting contents. In addition, other settings may be used as long as foreign matter information can be obtained through the processing to be explained later by using the photographic reference image data.

40

- ISO sensitivity: 200
- Edge emphasis: no
- Gradation correction: Standard
- Image quality mode: fine
- Image size: L
- 45 • F value: minimum aperture
- Exposure correction: no

50 [0039] After setting the photographing conditions in step S6, a decision is made in step S7 as to whether or not a photographing instruction has been issued. For this photographing operation, the user uses a uniform or homogeneous plane as the subject to obtain a reference image as explained earlier. In response to a photographing instruction issued by the user by operating the shutter release button or the like, the electronic camera 1 executes a photographing operation in the following step S8, and then, the captured image data (reference image data) are recorded into the memory card 30 shown in FIG. 2 in step S9. If it is decided in step S7 that a photographing instruction has not been issued, or after executing the processing in step S9, the operation returns to step S1.

55 [0040] As in the case of the correction target image data recorded in step S5, a file name is assigned and tag information is attached to the reference image data recorded into the memory card 30 in step S9. In step S9, "JPQ" is set as the extension of the file name and tag information indicating that the photographing operation was executed in the foreign matter information acquisition mode is attached. It is to be noted that the extension "JPQ" indicates that the

image file was photographed in the foreign matter information acquisition mode and was compressed through the JPEG method. It is also to be noted that another extension may be set as long as it is different from the extension set in step S5 and that the image may be compressed through another method. The image data do not even have to be compressed.

5 [0041] As explained above, the electronic camera 1 varies the file extension depending upon whether the captured image data recorded into the memory card 30 were photographed in the foreign matter information acquisition mode or the normal mode (step S5, step S9). In addition, the tag information indicating the specific photographing mode in which the photographing operation was executed is attached to the corresponding photographic image data file (step S5, step S9). Thus, it becomes possible to distinguish the photographic image data recorded into the memory card 30 as either reference image data or correction target image data.

10 [0042] The following is an explanation of the photographing procedure which is executed to first photograph a reference image in the foreign matter information acquisition mode and then photograph a correction target image in the normal mode through the processing explained above, given in reference to FIG. 4.

15 1) A photographing operation 201 is executed to photograph a uniformplane with the pupil position set to P0 and the aperture value set to A0, and reference image data 0 are output.
2) A normal photographing operation 202 is executed with the pupil position set to P1 and the aperture value set to A1, and correction target image data 1 are output.
20 3) A normal photographing operation 203 is executed with the pupil position set to P2 and the aperture value set to A2, and correction target image data 2 are output.
4) A normal photographing operation 204 is executed with the pupil position set to P3 and the aperture value set to A3, and correction target image data 3 are output. Namely, a photographing operation of the uniform plane is executed (uniform plane photographing) by turning the electronic camera 1 toward the sky or a wall surface, and then a photographing operation is executed as desired by turning the electronic camera 1 toward a subject to be photographed (normal photographing). It is to be noted that a correction target image that is an image photographed in the normal mode may be instead referred to as a normal image, a photographic image or a viewing image.

25 [0043] During this procedure, the aperture value is set to A0 so as to photograph a reference image with the aperture in the most constricted state within the range over which the aperture value can be adjusted at the variable optical system 3. The aperture value corresponding to the most constricted state may be, for instance, approximately F22 in the case of a standard lens. A correction target image, on the other hand, is photographed by setting the aperture value equal to that for the reference image or to a value further toward the open side.

30 [0044] The uniform plane photographing operation does not need to be executed repeatedly as long as the state of the foreign matter adhered to the optical component remains unchanged. While it is more desirable to execute the uniform plane photographing operation as often as possible, even foreign matter data obtained once a day prove useful under normal circumstances. It is up to the photographer to decide when to execute the uniform plane photographing operation. However, if a significant length of time has elapsed since the previous uniform photographing operation, the reference data obtained through the previous uniformplane photographing operation may not be reliable enough. Accordingly, the reference image data obtained through uniform plane photographing operation may be used only if the time interval between the uniform plane photographed in operation and the ensuing normal photographing operation is within a specific limit. In addition, the uniform plane photographing operation does not need to precede a normal photographing operation. Reference image data obtained through a uniform plane photographing operation executed after a normal photographing operation may be used. If a plurality of uniform plane photographing operations have been executed before and after the normal photographing operation, the reference image data obtained through the uniform plane photographing operation executed at a time closest to the normal photographing operation may be used. If, on the other hand, the user is concerned with the possibility of new foreign matter having become adhered to an optical component, reference image data selected from the two sets of reference image data corresponding to the two uniform plane photographing operations closest in time to the normal photographing operation may be used.

40 50 (Operation Executed on the Image Processing Apparatus Side)

55 [0045] The PC 31, which functions as the image processing apparatus, takes in the reference image data and the correction target image data described above via the memory card 30 and executes processing for eliminating the undesirable effect of the foreign matter. When taking in image data, the PC 31 distinguishes reference image data from correction target image data so as to be able to automatically select data having been identified as the reference image data to be used in the foreign matter effect elimination processing. FIG. 5 presents a flowchart of the processing executed at the PC 31 when taking into image data from the memory card 30. In step S11, one of the image files recorded in the memory card 30 is selected.

[0046] In the following step S12, a decision is made as to whether or not the image file selected in step S11 contains reference image data. This decision is made by checking the extension set in step S5 or S9 in FIG. 3. Alternatively, the decision may be made by using the tag information attached in step S5 or S9. If the extension "JPG" is set or if the tag information indicating that the image was photographed in the normal mode is attached to the image file, it is judged that the image file does not contain reference image data, i.e., that the image file contains correction target image data, and the operation proceeds to step S13. If, on the other hand, the extension "JPQ" is set or the tag information indicating that the image was photographed in the foreign matter information acquisition mode is attached to the image file, it is decided that the image file contains reference image data and the operation proceeds to step S14.

[0047] In step S13, the image file having been determined in step S12 to contain a correction target image is taken in from the memory card 30 and is stored into a memory or a hard disk. This image file is handled as a foreign matter effect elimination target during the foreign matter effect elimination processing to be detailed later.

[0048] In step S14, the image file having been determined in step S12 to contain reference image data is taken in from the memory card 30 and is stored into the memory or the hard disk. At this time, the image file is stored at a location different from the memory area into which the correction target image file is stored in step S13 and with a different directory address. This image file is used later to obtain a transmittance map when eliminating the undesirable effect of the foreign matter, as detailed below.

[0049] After executing the processing in step S13 or S14, a decision is made in step S15 as to whether or not all the image files stored in the memory card 30 have been selected. If there are image files that have not been selected yet, the operation returns to step S11 to select one of the files that have not been taken in yet. The processing in step S11 to step S15 described above is repeatedly executed until all the image files are taken in.

[0050] As described above, when taking reference image data and correction target image data into the PC 31, each image file is determined to contain reference image data or correction target image data based upon the file extension or the tag information (step S12), and reference image data and correction target image data are stored into memory areas and directory locations different from each other (step S13, step S14). Thus, reference image data can be automatically selected to be used in the foreign matter effect elimination processing explained below without necessitating a user image selection.

[0051] It is to be noted that while the image data being taken into the PC 31 are distinguished as either reference image data or correction target data and are stored into a specific location in correspondence to the data type in the explanation given above, the present invention is not limited to this example. For instance, all the image data taken into the PC 31 may be stored at the same location and reference image data may be selected from the image data having been taken into the PC 31 by checking the file extensions and the tag information as necessary.

[0052] Processing is executed as explained below to eliminate the undesirable effect of foreign matter from the correction target image data by using the reference image data and the correction target image data having been taken in as described above. It is to be noted that if a plurality of sets of reference image data have been taken in, the reference image data most suitable for different sets of correction target image data are individually selected in compliance with the selection criteria explained earlier, i.e., based upon file generation dates/times recorded in the tag information attached to the files.

[0053] It is to be noted that the following explanation is given by assuming that each set of reference image data or correction target image data input to the PC 31 functioning as the image processing apparatus include embedded data which enable the identification of the pupil position and the aperture value. The pupil position data may be obtained through a calculation executed based upon recorded data embedded in the photographic data and indicating the lens type, the zoom position and the focal point position by using a conversion table. FIG. 6 presents a flowchart of the processing executed by the PC 31.

(Processing on Reference Image Data)

1) Generation of brightness plane

[0054] In step S21 in FIG. 6, a brightness or luminance plane is generated. A brightness signal is generated from the R, G and B signals in correspondence to each pixel [i,j] constituting the reference image data by using the following expression (1). [i,j] indicates the position of the specific pixel.

$$Y[i,j] = (R[i,j] + 2*G[i,j] + B[i,j]) / 4 \quad (1)$$

[0055] Although an analysis can be executed in correspondence to the R, G and B planes individually, the effect of a foreign matter shadow basically manifests simply as a signal attenuation regardless of the color component. Accordingly, the color component signals are converted to a brightness component with which the effect of random noise can

be lowered by making the most of all the available information. This also speeds up the processing since only a single plane representing the brightness component, instead of the three planes corresponding to R, G and B, needs to be analyzed. The RGB ratio for the brightness component generation does not need to be that used in the expression above, and instead, it may be set to; R:G:B = 0.3:0.6:0.1, for instance.

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2) Transmittance map generation (gain map extraction)

[0056] In step S22, a transmittance map is generated (a gain map is extracted) by executing the following processing.

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2-1) Local standardization processing (gain extraction processing)

[0057] The reference image data may not be necessarily completely uniform, as explained earlier. For this reason, the brightness plane that has been generated may not be completely uniform either. A transmittance signal $T[i,j]$ is calculated with the following expression (2) for each pixel by executing standardization (or normalization) processing to locally standardize each pixel value on such a brightness plane. Namely, the relative ratio of the value corresponding to each target pixel $[i,j]$ and the average pixel value over a local range containing the target pixel is calculated. Through this processing, any non-uniformity attributable to the gradation, shading or the like in the uniform plane data is successfully eliminated by using an algorithm and it becomes possible to extract lowered transmittance attributable to the foreign matter shadow alone. The transmittance ascertained as described above over the entire image plane is referred to as a transmittance map (gain map). A transmittance map provides information on defects present in the reference image. It is to be noted that the term "pixel value" refers to a value indicated by a color signal (color information) corresponding to a color component or a value indicated by the brightness signal (brightness information) at each pixel. The pixel value is a value within a range of 0 ~ 255 when, for instance, expressed in 1 byte.

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$$T[i,j] = \frac{Y[i,j]}{\left(\sum_{m=i-a}^{i+a} \sum_{n=j-b}^{j+b} Y[i+m, j+n] \right) / (2a+1)(2b+1)} \dots \quad (2)$$

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[0058] The range over which the local average among $(2a+1) \times (2b+1)$ pixels is calculated should be larger than the diameter of the foreign matter. Ideally, an area that is at least 3 times as large as the foreign matter shadow should be set for the range to obtain accurate transmittance data. "a" indicates the number of pixels present to the left/right of the target pixel $[i,j]$ and b indicates the number of pixels present above/below the target pixel $[i,j]$. For instance, if the pixel pitch at the image-capturing element 8 is 12 μ m and the distance between the image-capturing surface and the surface on which foreign matter is adhered is 1.5 mm, the diameter of the large foreign matter ranges over approximately 15 pixels with the aperture value set at F22 and ranges over approximately 40 pixels with the aperture value set at F4. Accordingly, "a" and "b" should each be set to 40 so as to set the local averaging range over 81 x 81 pixels. However, this is only an example and a range containing a different number of pixels may be used.

[0059] The aperture value greatly affects the seriousness of a foreign matter shadow, and while the effect of small foreign matter can be easily eliminated by opening the aperture, the effect of large foreign matter may become less noticeable but still be present over a significant area even when the aperture is adjusted to the open side. Depending upon the pixel pitch width at the image-capturing element, a round foreign matter shadow may manifest over several tens of pixels even when the aperture is adjusted toward the open side, and in such a case, the local average must be taken over a very large range to result in an increase in the length of processing time. Under such circumstances, the processing may be speeded up by calculating the local average with sub-sampled pixels.

[0060] The processing for calculating the relative ratio over the $(2a+1) \times (2b+1)$ pixel range is referred to as local standardization processing (gain extraction processing). The filter used when calculating the relative ratio over the $(2a+1) \times (2b+1)$ pixel range may instead be referred to as a gain extraction kernel. FIGS. 7A and 7B illustrate the local standardization processing executed on the brightness plane. FIG. 7A shows the brightness signals at pixels ranging along the horizontal direction within the brightness plane. Reference numerals 41 and 42 each indicate a brightness signal attenuated due to the presence of foreign matter. FIG. 7B shows the results of the local standardization processing described above executed on the brightness signals in FIG. 7A. Namely, it shows the results of standardization processing executed on pixel values within the local range. Reference numerals 43 and 44, which correspond to reference numerals 41 and 42 in FIG. 7A, each indicate the transmittance at a point at which foreign matter is present. As illustrated in FIGS. 7A and 7B, any unevenness in the gradation, shading and like contained in the uniform plane data is eliminated, and only the reduction in the transmittance attributable to the foreign matter shadow can be extracted.

As a result, the position of the foreign matter and the level of the transmittance can be ascertained at once.

2-2) Low pass processing of the transmittance map

5 [0061] While low pass processing of the transmittance map may be omitted, it is still desirable to execute the low pass processing since it proves effective in most cases. The transmittance signal $T[i,j]$ contains random noise attributable to quantum fluctuations in the brightness signal, and for this reason, if the threshold value decision-making described in 2-4) below is executed in an area over which the transmittance levels remain close to 1 and subtle effects of a foreign matter shadow are discernible, the foreign matter shadow may be extracted in a mottled pattern due to randomness. The appearance of the image area can be somewhat improved by grouping the foreign matter shadow fragments with a low pass filter, the function of which is expressed in the following expression (3).

$$15 \quad \begin{aligned} T[i,j] = & \{4*T[i,j] \\ & +2*(T[i-1,j]+T[i+1,j]+T[i,j-1]+T[i,j+1]) \\ & +1*(T[i-1,j-1]+T[i-1,j+1]+T[i+1,j-1]+T[i+1,j+1])\}/16 \end{aligned} \quad (3)$$

20 2-3) Statistical analysis of the transmittance map

25 [0062] A statistical analysis of the transmittance map is executed to obtain an average value m by using expression (4) and determine a standard deviations by using expression (5) over the entire image plane corresponding to the transmittance map obtained through the local standardization processing. It is to be noted that N_x and N_y respectively indicate the total numbers of pixels set along the x direction and the y direction.

$$30 \quad m = \frac{1}{N_x N_y} \sum_{i,j} T[i,j] \dots \quad (4)$$

$$35 \quad \sigma = \sqrt{\frac{1}{N_x N_y} \sum_{i,j} (T[i,j] - m)^2} \dots \quad (5)$$

40 2-4) Threshold value decision-making

45 [0063] Basically, the areal ratio of foreign matter signals in the transmittance map is extremely small, and for this reason, the level of the random noise (shot-noise) attributable to quantum fluctuations in each transmittance signal is evaluated through the statistical analysis detailed in 2-3). The presence of such subtle random noise is indicated in an enlargement 46 of the area assigned with reference numeral 45 in FIG. 7A. A histogram of the transmittance map indicates a normal distribution with the standard deviation σ around the average value m (m is a value very close to 1). FIG. 8 shows the histogram of the transmittance map. Since the transmittance can be assumed to remain unaffected by the presence of foreign matter shadows over this fluctuation range, the transmittance can be set to 1 forcibly. In other words, the threshold value decision-making may be executed in accordance with the following conditions (6) and (7),

$$55 \quad \text{if } |T[i,j] - m| \leq 3\sigma \quad \text{then } T[i,j] = 1 \dots \quad (6)$$

$$\text{else } T[i,j] = T[i,j] \dots \quad (7)$$

[0064] The normally distributed random data account for 99.7% over the $\pm 3\sigma$ range and thus, the effect of the random

noise can be substantially eliminated with accuracy. Any signal indicating a transmittance outside the $\pm 3\sigma$ range can be considered to be an abnormal signal which can hardly be explained as attributable to a statistical error and can be assumed to represent a phenomenon induced by a lowered transmittance due to the presence of a foreign matter shadow. When an abnormality is induced by foreign matter, the abnormal signal indicates a value smaller than 1 under normal circumstances.

[0065] However, some abnormal signals may indicate values larger than 1 although such an occurrence is relatively rare. This phenomenon is not attributable to a foreign matter shadow but is attributable to, for instance, an interference fringe that manifests as a defect occurring at stria (non-uniformity in the refractive index) at an optical low pass filter or the like, increases or decreases the intensity of the incident light. Thus, the method may be adopted to detect a defect in an optical member as well as to detect foreign matter present in the optical path. In addition, the method may be adopted to determine the extent of the effect of a pixel defect manifesting within the image-capturing element. While foreign matter present close to the image-capturing element 8 tends to show clearly in a photographic image, even foreign matter on the photographic lens which becomes fairly blurred in the photographic image can be identified with a high degree of accuracy.

[0066] It is to be noted that threshold value decision-making should be executed in accordance with conditions (8), (9) and (10) below in order to eliminate the effect of foreign matter shadow alone.

20 if $|T[i,j]-m| \leq 3\sigma$ then $T[i,j]=1$... (8)

 else if $T[i,j] > 1$ $T[i,j]=1$... (9)

 else $T[i,j]=T[i,j]$... (10)

25 [0067] Since the average m used in the decision-making is always a value close to 1, it may be substituted by 1.

[0068] As explained above, two types of defect information, i. e., map information representing the position of a defective pixel (judged to be defective or defect free by deciding whether or not $T = 1$) and transmittance information indicating the extent of the defect, are obtained at once. It is to be noted that the transmittance map, which indicates the local relative gains, may be referred to as a gain map instead.

[0069] Under normal circumstances, defects such as foreign matter are detected by using an edge detection differential filter. However, the contrast between the shadows of foreign matter present in the optical path which become optically blurred, and their surroundings is extremely low. In such a case, the differential filter, the sensitivity level of which is very low, can hardly detect any foreign matter. Instead, the statistical characteristics of the transmittance may be used in the decision-making processing as described above to detect foreign matter with an extremely high level of sensitivity, and as a result, it becomes possible to correct the undesirable effect of foreign matter present in the optical path thereby achieving the object of the present invention.

3) Pupil position conversion of the transmittance map

40 [0070] In step S23, the transmittance map is converted corresponding to the pupil position. The pupil position conversion is executed when the pupil position set to photograph the reference image and the pupil position set to photograph the correction target image are different from each other to convert a foreign matter position in the reference image to a foreign matter position at which the foreign matter is predicted to appear as it is viewed from the pupil position of the correction target image. FIGS. 9A and 9B show how the position of the foreign matter shadow changes as the pupil position changes. FIG. 9A shows the relationship among the pupil position, the foreign matter and the image-capturing surface of the image-capturing element 8. FIG. 9B shows how the foreign matter shadow moves on the image-capturing surface as the pupil position changes.

50 [0071] As FIGS. 9A and 9B clearly indicate, the position of the foreign matter appearing within the image becomes offset along the radius vector from an optical axis 51, i.e., the image center, as the pupil position changes. Bearing this in mind, an offset quantity Δr by which the foreign matter present at a position distance from the optical axis 51 within the image by r becomes offset along the radius vector is estimated. When the P_0 represents the pupil position set for the reference image, P_0' represents the pupil position set for the correction target image and the foreign matter is adhered at a position distanced from the image-capturing surface by 1, Δr be calculated by using expression (11) presented below.

$$\Delta r = r \cdot \frac{l}{P_0' - l} \cdot \frac{P_0 - P_0'}{P_0} \quad (11)$$

5 It is to be noted that the distance l is a value obtained by converting the thickness of the optical component to the optical path length in the air.

[0072] The transmittance map $T[i,j]$ of the reference image is displaced to $[r',\theta]$ on polar coordinates $[r,\theta]$ by using the following expression (12) and thus, is converted to a transmittance map $T'[i,j]$ on coordinates $[i,j]$.

10

$$r' = r + \Delta r = r \left(1 + \frac{l}{P_0' - l} \cdot \frac{P_0 - P_0'}{P_0} \right) \dots \quad (12)$$

15

The offset quantity Δr increases as the distance from the optical axis 51 increases. At the peripheral area of an actual image, the offset quantity may be equivalent to several tens of pixels, depending upon the value set for the pupil position.

20 4) F value conversion of the transmittance map

[0073] In step S24, the transmittance map undergoes an F value conversion. Namely, if the aperture value set to capture the reference image and the aperture value set to capture the correction target image are different from each other, the foreign matter diameter and the corresponding transmittance in the reference image undergo an F value conversion to be converted to a foreign matter diameter and a transmittance corresponding to the aperture value set further toward the open side to capture the correction target image. FIGS. 10A and 10B show how the size of a foreign matter shadow changes as the F value representing the aperture value changes. FIG. 10A shows the foreign matter shadow at a large F value setting, whereas FIG. 10B shows the foreign matter shadow at a small F value setting. As FIGS. 10A and 10B clearly indicate, the correlation between the distance l from the image-capturing surface to the foreign matter position and the foreign matter size Γ can be expressed as in (13) below by incorporating the defining expression of the F value ($F = \text{focal length/lens effective aperture}$).

$$\Gamma = \frac{l}{F} \quad (13)$$

35 [0074] The foreign matter diameter can be expressed as a number of pixels by dividing l by the pixel pitch a (mm / pixel) at the image-capturing element. Thus, the foreign matter as a point image is estimated to spread over the width Γ when the aperture is set at F .

[0075] At the same time, since the foreign matter shadow is considered to be enlarged as light is uniformly irradiated on the foreign matter forming the point image from the individual angles of incidence at the lens opened to the aperture value, the distribution function of the point image can be assumed to be a function with a completely homogeneous spread. Accordingly, by executing homogeneous low pass filter processing expressed with a number of pixels corresponding to the filter width Γ , an F value conversion with which the foreign matter diameter and the transmittance can be predicted with a high degree of accuracy is enabled. While the low pass filter used in this application is normally a non-separation type filter formed in a circular shape having a diameter Γ , a separation type filter formed in a square shape having longitudinal and lateral sides set to Γ may instead be used to speed up the processing.

[0076] Let us now consider an example in which $l = 0.5\text{mm}$, $a = 5\mu\text{m/pixel}$ and a transmittance map corresponding to the aperture value F22 is converted to transmittance maps corresponding to F16, F11, F8, F5.6 and F4. The one-dimensional filter coefficients of the square separation type filter can be set as indicated in FIG. 11. The low pass filter processing is executed both along the vertical direction and along the horizontal direction by using the one-dimensional filter coefficients indicated in FIG. 11. It is to be noted that the one-dimensional filter coefficients corresponding to the aperture F16 include a total of seven coefficients with the coefficient 0.5 set at both ends, so as to filter a shadow spread over a width represented by an even number over a range that expands uniformly along the horizontal direction and the vertical direction with a width represented by an odd number around the target pixel. FIG. 12 shows the aperture F16 filter represented as a two-dimensional filter.

[0077] Through the conversion processing described above, the transmittance map of the reference image is converted to the transmittance map corresponding to the pupil position and the F value set to capture the correction target image. In other words, the transmittance map of the reference image is converted to a transmittance map equivalent to a transmittance map that would be generated under the optical conditions with which the correction target image was

photographed.

(Processing on the Correction Target Image)

5 (5) Gain correction

[0078] In step S25 in FIG. 6, a gain correction is executed by using the transmittance map obtained through the conversion processing explained above. The gain correction is executed by multiplying the R, G and B values in the correction target image data with the reciprocal of the value indicated by the transmittance signal having undergone 10 the pupil position / F value conversion, as indicated in expressions (14), (15) and (16) respectively.

$$R[i,j] = R[i,j]/T'[i,j] \quad (14)$$

15 $G[i,j] = G[i,j]/T'[i,j] \quad (15)$

20 $B[i,j] = B[i,j]/T'[i,j] \quad (16)$

[0079] FIG. 13 shows how the transmittance is converted through the F value conversion over an area where foreign matter of medium size is present. The pixel position is indicated along the horizontal axis, and the transmittance is indicated along the vertical axis.

[0080] As described above, once a reference image is photographed with the aperture value set to the smallest value 25 in a variable optical system, another reference image does not need to be photographed under different optical conditions. Namely, by converting the foreign matter data in the single reference image, an effective correction can be achieved. As a result, the onus placed on the user of the electronic camera is greatly reduced. In addition, a very high level of sensitivity in the foreign matter detection performance can be maintained without having to photograph a completely uniform image.

[0081] In the electronic camera 1 described above, the extension and the tag information stored in the memory card 30 together with a reference image data file are different from those stored in the memory card 30 together with a correction target image data file. Thus, when the image processing apparatus executes the processing for eliminating the foreign matter effect by taking in a data file, reference image data are automatically selected without requiring a user data file selection.

[0082] It is to be noted that data files of reference image data and correction target image data appended with 35 extensions and tag information contents different from each other are stored in the memory card 30 and the data files are then taken into the PC 31 via the memory card 30 in the embodiment described above. Instead, such data files containing reference image data and correction target image data may be taken into the PC 31 via the external interfaces 23.

[0083] In addition, a transmittance map is generated by executing the local standardization processing and the like 40 on a reference image of a supposedly substantially uniform plane photographed by the photographer in the embodiment. However, there may be in a small pattern or the like present in the reference image considered to be substantially uniform by the photographer. This problem can be basically solved by photographing the subject in an unfocused state. For instance, the photographer may photograph the subject by positioning it at a position closer than the shortest 45 photographing distance of the lens. As long as the small pattern is photographed as an unfocused image that changes gently over a larger range than the range of the gain extraction kernel corresponding to $(2a+1) \times (2b+1)$ pixels, a reference image which is uniform enough to fulfill the purpose can be obtained.

[0084] While the image-capturing element in the embodiment adopts a Bayer array R, G and B colorimetric system, it goes without saying that no restrictions whatsoever are imposed with regard to the arrangement of the color filters 50 as long as the required interpolation processing can be executed. Furthermore, the image-capturing element may adopt a different colorimetric system (such as the complementary colorimetric system).

[0085] Moreover, while an explanation is given above in reference to the embodiment on an example in which the present invention is adopted in a single lens reflex electronic still camera in which interchangeable lenses are used, the present invention is not limited to this example. The present invention may be adopted, for instance, in a camera 55 that does not allow the use of interchangeable lenses. The pupil position and the aperture value can be ascertained by using an appropriate method in the known art.

[0086] In addition, while image data obtained by photographing images with the electronic still camera 1 are processed in the embodiment explained above, the present invention is not limited to this example. The present invention

NOTE: 37 C.F.R. Section 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . issue fee." From the wording of 37 C.F.R. Section 1.28(b), (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

16. Instructions as to Overpayment

NOTE: "... Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts. Amounts over twenty-five dollars may be returned by check or, if

like. In other words, the present invention maybe adopted in all types of the apparatuses that handle image data.

[0088] The program executed by the PC 31 may be provided in a recording medium such as a CD ROM or through a data signal on the Internet or the like. FIG. 14 shows how the program may be provided in those forms. The program is provided to the PC 31 via the CD ROM 34. In addition, the PC 31 can be connected with a communication line 101.

A computer 102 is a server computer that provides the program stored in a recording medium such as a hard disk 103. The communication line 101 may be a communication line for Internet communication, personal computer communication or the like, or it may be a dedicated communication line. The computer 102 reads out the program from the hard disk 103 and transmits the program to the PC 31 via the he communication line 101. In other words, the program is provided as a data signal on a carrier wave transmitted via the he communication line 101. Thus, the program can be distributed as a computer-readable computer program product adopting any of various modes such as a recording medium or a carrier wave.

[0089] The above described embodiments are examples, and various modifications can be made without departing from the spirit and scope of the invention.

25 Claims

1. An image-capturing apparatus, comprising:

an image-capturing unit that captures an image of a subject through an optical system; and
30 a control unit that outputs images captured at the image-capturing unit as image data files, wherein:

the control unit outputs the image data files in a format that allows an image data file containing a normal image to be distinguished from an image data file containing a reference image to be used to correct an image defect in the normal image.

35 2. An image-capturing apparatus according to claim 1, further comprising:

a mode setting unit that sets a reference image acquisition mode in which the reference image is to be obtained, wherein:

40 the control unit designates an image captured by the image-capturing unit when the reference image acquisition mode is set as the reference image.

3. An image-capturing apparatus according to any one of claims 1 through 2, wherein:

45 the control unit appends different extensions to the image data file containing the normal image and the image data file containing the reference image.

4. An image-capturing apparatus according to any one of claims 1 through 3, wherein:

50 the image data files are each constituted of image data corresponding to pixels in the image and information related to the image; and

the control unit stores information with which the image data file containing the normal image and the image data file containing the reference image can be distinguished from each other in the information related to the image.

55 5. An image-capturing apparatus comprising:

Incorporation by reference of added pages

(check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED)

Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed

Number of pages added 8

Plus Added Pages for Papers Referred to in Item 4 Above

Number of pages added _____

Plus added pages deleting names of inventor(s) named on prior application(s) who is/are no longer inventor(s) of the subject matter claimed in this application.

Number of pages added _____

Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added _____

Statement Where No Further Pages Added

(if no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item)

This transmittal ends with this page.

**ADDED PAGES FOR APPLICATION TRANSMITTAL WHERE BENEFIT OF
PRIOR U.S. APPLICATION(S) CLAIMED**

NOTE: See 37 CFR 1.78.

17. Relate Back

WARNING: *If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. 120, 121 or 365(c). (35 U.S.C. 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.*

(complete the following, if applicable)

A separate Preliminary Amendment amends the specification by inserting, before the first line, the following paragraph:

A. 35 U.S.C. 119(e)

NOTE: 37 C.F.R. § 1.78(a)(4) and (5):

"(4) A nonprovisional application, other than for a design patent, or an international application designating the United States of America may claim an invention disclosed in one or more prior-filed provisional applications. In order for an application to claim the benefit of one or more prior-filed provisional applications, each prior-filed provisional application must name as an inventor at least one inventor named in the later-filed application and disclose the named inventor's invention claimed in at least one claim of the later filed application in the manner provided by the first paragraph of 35 U.S.C. 112. In addition, each prior-filed provisional application must be entitled to a filing date as set forth in § 1.53(c), and the basic filing fee set forth in § 1.16(k) must be paid within the time period set forth in § 1.53(g).

"(5)(i) Any nonprovisional application or international application designating the United States of America claiming the benefit of one or more prior-filed provisional applications must contain or be amended to contain a reference to each such prior-filed provisional application, identifying it by the provisional application number (consisting of series code and serial number).

(ii) This reference must be submitted during the pendency of the later-filed application. If the later-filed application is an application filed under 35 U.S.C. 111(a), this reference must also be submitted within the later of four months from the actual filing date of the later-filed application or sixteen months from the filing date of the prior-filed provisional application. IF the later-filed application is a nonprovisional application which entered the national stage from an international application after compliance with 35 U.S.C. 371, this reference must also be submitted within the later of four months from the date on which the national stage commenced under 35 U.S.C. 371(b) or (f) in the later-filed international application or sixteen months from the filing date of the prior-filed provisional application. These time periods are not extendable. Except as provided in paragraph (a)(6) of this section, the failure to timely submit the reference is considered a waiver of any benefit under 35 U.S.C. 119(e) to such prior-filed provisional application. The time periods in this paragraph do not apply if the later-filed application is:

(A) An application filed under 35 U.S.C. 111(a) before November 29, 2000; or

(B) A nonprovisional application which entered the national stage after compliance with 35 U.S.C. 371 from an international application filed under 35 U.S.C. 363 before November 29, 2000.

(iii) If the later-filed application is a nonprovisional application, the reference required by this paragraph must be included in an application data sheet (§ 1.76), or the specification must contain or be amended to contain such reference in the first sentence following the title."

[X] "This application claims the benefit of U.S. Provisional Application(s) No(s).:

APPLICATION NO(S).:

60 / 413,000
60 / 438,338
 /

FILING DATE

SEPTEMBER 23, 2002
JANUARY 7, 2003

and incorporates the same by reference."

WARNING: 37 C.F.R. § 1.78(5)(iv): "(iv) If the prior-filed provisional application was filed in a language other than English and an English-language translation of the prior-filed provisional application and a statement that the translation is accurate were not previously filed in the prior-filed provisional application or the later-filed nonprovisional application, applicant will be notified and given a period of time within which to file an English-language translation of the non-English-language prior-filed provisional application and a statement that the translation is accurate. In a pending nonprovisional application failure to timely reply to such a notice will result in abandonment of the application."

Language of Prior Filed Provisional Application

(Supply information for each provisional the benefit of which is being claimed)

The above identified prior filed provisional application whose benefit is being claimed

[] was filed in the English language,

[] was filed in a language other than English and an English translation along with a statement that the translation is accurate was filed in the provisional application, or

[] was filed in language other than English and an English translation along with a statement that the translation is accurate is filed herewith.

B. 35 U.S.C. 120, 121 and 365(c)

WARNING: The applicable provisions for the time and manner of claiming the benefit of a prior U.S. application filing date are set forth in 37 C.F.R. § 1.78(a)(1) and (2) as follows:

"(a)(1) A nonprovisional application or international application designating the United States of America may claim an invention disclosed in one or more prior-filed copending nonprovisional applications or international applications designating the United States of America. In order for an application to claim the benefit of a prior-filed copending nonprovisional application or international application designating the United States of America, each prior-filed application must name as an inventor at least one inventor named in the later-filed application and disclose the named inventor's invention claimed in at least one claim of the later-filed application in the manner provided by the first paragraph of 35 U.S.C. 112. In addition, each prior-filed application must be:

(i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or

(ii) Complete as set forth in § 1.51(b); or

(iii) Entitled to a filing date asset forth in § 1.53(b) or § 1.53(d) and include the basic filing fee set forth in § 1.16; or

(iv) Entitled to a filing date as set forth in § 1.53(b) and have paid therein the processing and retention fee set forth in § 1.21(l) within the time period set forth in § 1.53(f).

(2)(i) Except for a continued prosecution application filed under § 1.53(d), any nonprovisional application or international application designating the United States of America claiming the benefit of one or more prior-filed copending nonprovisional applications or international applications designating the United States of America must contain or be amended to contain a reference to each such prior-filed application, identifying it by application number (consisting of the series code and serial number) or international application number and international filing date and indicating the relationship of the applications. Cross references to other related applications may be made when appropriate (see § 1.14).

(ii) This reference must be submitted during the pendency of the later-filed application. If the later-filed application is an application filed under 35 U.S.C. 111(a), this reference must also be submitted within the later of four months from the actual filing date of the later-filed application or sixteen months from the filing date of the prior-filed application. If the later-filed application is a nonprovisional application which entered the national stage from an international application after compliance with 35 U.S.C. 371, this reference must also be submitted within the later of four months from the date on which the national stage commenced under 35 U.S.C. 371(b) or (f) in the later-filed international application or sixteen months from the filing date of the prior-filed application. These time periods are not extendable. Except as provided in paragraph (a)(3) of this section, the failure to timely submit the reference required by 35 U.S.C. 120 and paragraph (a)(2)(i) of this section is considered a waiver of any benefit under 35 U.S.C. 120, 121, or 365(c) to such prior-filed application. The time periods in this paragraph do not apply of the later-filed application is:

(A) An application for a design patent;

(B) An application filed under 35 U.S.C. 111(a) before November 29, 2000; or

(C) A nonprovisional application which entered the national stage after compliance with 35 U.S.C. 371 from an international application filed under 35 U.S.C. 363 before November 29, 2000.

(iii) If the later-filed application is a nonprovisional application, the reference required by this paragraph must be included in an application data sheet (§ 1.76), or the specification must contain or be amended to contain such reference in the first sentence following the title.

(iv) The request for a continued prosecution application under § 1.53(d) is the specific reference required by 35 U.S.C. 120 to the prior-filed application. The identification of an application by application number under this section is the identification of every application assigned that application number necessary for a specific reference required by 35 U.S.C. 120 to every such application assigned that application number."

[] "This application is a

[] continuation

[] continuation-in-part

[] divisional

of copending

[] application number _____ filed on _____,
[] which is

[] International Application _____ filed on _____, which
designated the U.S., claims the benefit thereof and incorporates the same by reference."

NOTE: The proper reference to a prior filed PCT application that entered the U.S. national phase is the U.S. serial number and the filing date of the PCT application that designated the U.S.

NOTE: (1) Where the application being transmitted adds subject matter to the International Application, then the filing can be as a continuation-in-part or (2) if it is desired to do so for other reasons then the filing can be as a continuation.

[] "The nonprovisional application designated above, namely application _____ / _____, filed _____, claims the benefit of U.S. Provisional Application(s) No(s).: _____

APPLICATION NO(S).:

FILING DATE

____ / _____
____ / _____
____ / _____

and incorporates the same by reference"

C. Publication of International Application-Provisional Application

NOTE: 35 U.S.C. 154 *Contents and term of patent; provisional rights*

(d)(4) **REQUIREMENTS FOR INTERNATIONAL APPLICATIONS-**

(A) *EFFECTIVE DATE-The right under paragraph (1) to obtain a reasonable royalty based upon the publication under the treaty defined in section 351(a) of an international application designating the United States shall commence on the date on which the Patent and Trademark Office receives a copy of the publication under the treaty of the international application, or, if the publication under the treaty of the international application is in a language other than English, on the date on which the Patent and Trademark Office receives a translation of the international application in the English language.*

The international application corresponding to the instant application

[] was
[] was not

published under PCT Article 21(2) in the English language.

[] An English translation of the international application is attached.

18. Relate Back—35 U.S.C. 119 Priority Claim for Prior Application

NOTE: 37 C.F.R. § 1.55 *Claim for foreign priority*.

"(a) An applicant in a nonprovisional application may claim the benefit of the filing date of one or more prior foreign applications under the conditions specified in 35 U.S.C. 119(a) through (d) and (f), 172, and 365(a) and (b).

(1)(i) In an original application filed under 35 U.S.C. 111(a), the claim for priority must be presented during the pendency of the application, and within the later of four months from the actual filing date of the application or sixteen months from the filing date of the prior foreign application. This time period is not extendable. The claim must identify the foreign application for which priority is claimed, as well as any foreign application for the same subject matter and having a filing date before that of the application for which priority is claimed, by specifying the application number, country (or intellectual property authority), day, month, and year of its filing. The time period in this paragraph does not apply to an application for a design patent.

(ii) In an application that entered the national stage from an international application after compliance with 35 U.S.C. 371, the claim for priority must be made during the pendency of the application and within the time limit set forth in the PCT and the Regulations under the PCT."

(2) The claim for priority and the certified copy of the foreign application specified in 35 U.S.C. 119(b) or PCT Rule 17 must, in any event, be filed before the patent is granted. If the claim for priority or the certified copy of the foreign application is filed after the date the issue fee is paid, it must be accompanied by the processing fee set forth in § 1.17(i), but the patent will not include the priority claim unless corrected by a certificate of correction under 35 U.S.C. 255 and § 1.323.

The prior U.S. application(s), including any prior International Application designating the U.S., identified above in item 17B, in turn itself claim(s) foreign priority(ies) as follows:

Country	Appln. no.	Filed
Country	Appln. no.	Filed

The certified copy(ies) has (have)

been filed on _____, in prior U. S. national (not PCT) application _____, which was filed on _____.

is (are) attached.

will follow.

WARNING: *The certified copy of the priority application that may have been communicated to the PTO by the International Bureau may not be relied on without any need to file a certified copy of the priority application in the continuing application. This is so because the certified copy of the priority application communicated by the International Bureau is placed in a folder and is not assigned a U.S. serial number unless the national stage is entered. Such folders are disposed of if the national stage is not entered. Therefore, such certified copies may not be available if needed later in the prosecution of a continuing application. An alternative would be to physically remove the priority documents from the folders and transfer them to the continuing application. The resources required to request transfer, retrieve the folders, make suitable record notations, transfer the certified copies, enter and make a record of such copies in the Continuing Application are substantial. Accordingly, the priority documents in folders of international applications that have not entered the national stage may not be relied on. Notice of April 28, 1987 (1079 O.G. 32 to 46).*

19. Maintenance of Copendency of Prior Application

NOTE: The PTO finds it useful if a copy of the petition filed in the prior application extending the term for response is filed with the papers constituting the filing of the continuation application. Notice of November 5, 1985 (1060 O.G. 27).

A. [] Extension of time in prior application

[] A petition and fee extends the term in the pending prior application until _____.
[] A copy of the petition filed in prior application is attached.

B. [] Conditional Petition for Extension of Time in Prior Application

[] A conditional petition for extension of time is being filed in the pending prior application.
[] A copy of the conditional petition filed in the prior application is attached.

C. [] No extension is necessary in Prior Application

[] Issue Fee paid _____

20. Further Inventorship Statement Where Benefit of Prior Application(s) Claimed

(complete applicable item (a), (b) and/or (c) below)

(a) This application discloses and claims only subject matter disclosed in the prior application whose particulars are set out above and the inventor(s) in this application are

the same.

less than those named in the prior application. It is requested that the following inventor(s) identified for the prior application be deleted:

(type name(s) of inventor(s) to be deleted)

(b) This application discloses and claims additional disclosure and a new declaration or oath is being filed. With respect to the prior application, the inventor(s) in this application are

the same.

the following additional inventor(s) have been added:

(type name(s) of inventor(s) to be added)

(c) The inventorship for all the claims in this application are

the same.

not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made

is submitted.

will be submitted.

21. Abandonment of Prior Application (*if applicable*)

Please abandon the prior application at a time while the prior application is pending, or when the petition for extension of time or to revive in that application is granted, and when this application is granted a filing date, so as to make this application copending with said prior application.

NOTE: According to the Notice of May 13, 1983 (103, TMOG 6-7), the filing of a continuation or continuation-in-part application is a proper response with respect to a petition for extension of time or a petition to revive and should include the express abandonment of the prior application conditioned upon the granting of the petition and the granting of a filing date to the continuing application.

22. Petition for Suspension of Prosecution for the Time Necessary to File an Amendment

WARNING: *"The claims of a new application may be finally rejected in the first Office action in those situations where (1) the new application is a continuing application of, or a substitute for, an earlier application, and (2) all the claims of the new application (a) are drawn to the same invention claimed in the earlier application, and (b) would have been properly finally rejected on the grounds of art of record in the next Office action if they had been entered in the earlier application." MPEP, § 706.07(b).*

NOTE: *Where it is possible that the claims on file will give rise to a first action final for this continuation application and for some reason an amendment cannot be filed promptly (e.g., experimental data is being gathered) it may be desirable to file a petition for suspension of prosecution for the time necessary.*

(check the next item, if applicable)

There is provided herewith a Petition To Suspend Prosecution for the Time Necessary to File An Amendment (New Application Filed Concurrently)

23. NOTIFICATION IN PARENT APPLICATION OF THIS FILING

A notification of the filing of this
(check one of the following)

continuation

continuation-in-part

divisional

is being filed in the parent application, from which this application claims priority under 35 U.S.C. § 120.